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Ce rapport fait état d'un projet visant à développer, à expérimenter et à évaluer un programme d'étude pour des élèves dont le rendement scolaire est très faible. Le programme est basé sur l'hypothèse qu'un élève apprend mieux si on tient compte de son style d'apprentissage. Un groupe de quinze élèves de la 3e à la 6e année a participé au projet. La réalisation du projet s'est faite en quatre étapes: 1. mise au point d'un profil du style d'apprentissage de chaque élève; 2. élaboration des programmes d'étude individualisés; 3. expérimentation des programmes; 4. évaluation. Pour évaluer l'efficacité du programme, on a administré des pré-tests et des post-tests en anglais et en mathématiques. De plus, les professeurs ont eu à observer s'il y avait eu un changement chez les élèves du point de vue du travail de classe, du comportement et du développement des caractéristiques affectives. Les résultats des tests et de l'évaluation ont montré que l'effet du programme sur le rendement scolaire des élèves a été positif mais restreint.

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INTRODUCING INSTRUCTIONAL STRATEGIES BASED ON LEARNING STYLES:
A PROGRAM DESIGNED FOR ACADEMICALLY WEAK STUDENTS

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The Protestant School Board of Greater Montreal
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Introducing Instructional Strategies Based on Learning Styles:

A Program Designed for Academically Weak Students

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Résumé

Le but de ce projet était de développer, d'expérimenter et d'évaluer un programme d'étude pour des élèves dont le rendement scolaire est très faible. Le programme est basé sur la notion qu'un élève apprend mieux si on tient compte de son style d'apprentissage. Un groupe de quinze élèves de la 3e à la 6e année a participé au projet. Un groupe témoin était inclus pour but de comparaison.

La réalisation du projet s'est faite en quatre étapes: (1) mise au point d'un profil du style d'apprentissage de chaque élève, (2) élaboration des programmes d'étude individualisés, (3) expérimentation des programmes et (4) évaluation.

Pour évaluer l'efficacité du programme, on a administré des pré-tests et des post-tests en anglais et en mathématiques. De plus, on a demandé aux professeurs de conduire une évaluation informelle pour voir s'il y avait eu un changement chez les élèves du point de vue du travail de classe, du comportement et du développement des caractéristiques affectives.

Les résultats des tests d'anglais et de mathématiques indiquent que: (1) Le rendement du groupe expérimental s'est nettement amélioré à trois tests: vocabulaire, orthographe et structures grammaticales, tandis que chez le groupe témoin il n'y a pas eu de changement significatif. (2) L'habileté de se concentrer sur la tâche s'est améliorée davantage chez le groupe expérimental que chez le groupe témoin. (3) A la fin de la période d'expérimentation, le rendement scolaire des élèves expérimentaux de 3e année a été moyen ou au-dessus de la moyenne à presque tous les tests; le rendement scolaire des autres élèves du groupe expérimental ainsi que celui du groupe témoin ont été au dessous de la moyenne à la plupart des tests. Les résultats de l'évaluation informelle indiquent qu'il y a eu un changement positif chez les élèves du point de vue du travail de classe et du comportement ainsi que dans le développement des caractéristiques affectives.

On en a conclu que l'effet du programme sur le rendement scolaire des élèves a été positif mais restreint. Ce résultat est attribué principalement au temps limité qui a été consacré à l'expérimentation du programme et à une adaptation insuffisante aux besoins créés par le style d'apprentissage de chaque élève.

Summary

The purpose of this project was to develop, implement and evaluate a special program of study for academically weak students. The program is based on the notion that students learn better when they are allowed to study in settings that are congruent with their individual learning styles. A group of fifteen students from grades 3 - 6 participated in the project. A control group was included for comparison purposes.

The project consisted of four parts: (1) construction of a learning style profile for each student; (2) development of individualized study programs, (3) implementation of the study programs and (4) evaluation.

Pre-and post-tests in English and mathematics were administered to assess academic achievement. An informal evaluation was carried out by the teachers to see whether there had been a change in any of the following three areas: (1) school work, (2) behavioral patterns and (3) affective characteristics.

The results of the formal evaluation show that: (1) The performance of the experimental group improved significantly more than that of the control group on three tests: vocabulary, spelling and usage. (2) There was greater improvement in the ability to keep on task among the experimental students than among the controls. (3) At the end of the implementation period, the grade 3 experimental students performed at or above grade level on practically all the tests; the other experimental students and all the controls performed below grade level on most of the tests. The results of the informal evaluation show that there was an overall improvement in school work and in the development of behavioral and affective characteristics.

The findings lead to the conclusion that the program had a positive though limited effect on the students' academic achievement. The outcome is attributed primarily to the relatively short duration of the implementation period and to an insufficient accommodation of learning style preferences.

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Introduction

Students at all grade levels vary greatly in their ability to cope with the academic program. In order to address this issue, educators have increasingly focused on individual student needs. A central issue in this endeavor is the identification of the underlying cause associated with each learner's poor scholastic performance. Often a student's inability to achieve within the expected norms arises from identifiable learning disabilities. At other times, underachievement can be attributed to emotional problems and/or to the socio-economic background of the family. However, sometimes there seems to be no apparent reason for the learner's inability to experience success in school.

From the pedagogical perspective, remedies for underachievement have focused more on the level of difficulty of the material to be learned than on the method through which this material is taught (Talmadge and Shearer, 1969). Hence, the treatment often consists of slower progression, more repetition and increased feed-back to the learner. Some of this work is done in the classroom. At other times, the student is directed to a free flow teacher. Both approaches, particularly when they complement each other,

often show very positive results. Nevertheless, there are many students who do not seem to benefit from conventional types of intervention programs. The problem seems especially acute in the areas of language arts and mathematics where cumulative deficits are much more difficult to remedy.

The continued effort to try and help underachievers has led some educators to investigate more closely a broad range of factors that seem to affect learning capacity. Their basic assumption is that learners differ from one another in the way certain stimuli affect their classroom performance and that the contexts in which each learner functions optimally need to be taken into account when remedial work is prescribed. Many of these features are not novel to the experienced teacher. For instance, some children learn well in a small group situation, whereas others do better on their own. Certain learners respond well to orally presented material, whereas others are more receptive to visual stimuli. Learners also differ in their perseverance to complete tasks and in their need for mobility. Other factors, such as light and temperature conditions in the classroom and the time of day during which a learner's energy level is high have remained largely unrecognized to date. Yet, there seems to be evidence that all of these factors can play a role in the learning process although the

extent to which they affect achievement varies across learners. Much of the pioneering work in this area has been conducted by Dunn and Dunn (1978) who postulate that every learner has a specific learning style and who have developed new individualized instructional approaches to meet the needs created by this learning style.

Learning Style Theory

Learning style theory can best be defined as "...the way individuals concentrate on, absorb and retain new or difficult information or skills. "(Dunn, 1983:496). According to Dunn and Dunn (1978), a person's learning style is made up of elements from five different domains: (1) environmental, (2) emotional, (3) sociological, (4) physical and (5) psychological. Research into the effect of these elements on scholastic achievement shows a noticeable improvement in performance when students are allowed to learn under conditions that are congruent with their learning style.

The light condition in the classroom, for example, is a condition that, as noted earlier, is generally not associated with academic performance. Yet, research indicates that some students, particularly poor readers, often prefer to learn in dim light, a condition that

contrasts sharply with the usually brightly lit classroom (Dunn and Dunn, 1978; Price, 1980; Carbo, 1983). Krinsky (1982) found that fourth graders with strong preferences for either bright or dim light read faster and more accurately when they were tested in lighting conditions that matched their illumination preferences.

Other studies show that seating arrangements in the classroom (Shea, 1983) and time of day (Virostko, 1983) also influence performance. Lynch (1981) found a strong correlation between truancy and time of day preferences. He noted that truants demonstrate high energy in the late morning and in the afternoon. When these students' schedules were set so as to take this preference into account, the rate of truancy was significantly reduced.

Food intake, and the need for mobility are another two elements on which high and low reading achievers show different preferences. Price, Dunn and Sanders (1981) tested students in grades 3 - 8 and found that poor readers have generally a greater need for frequent food intake and mobility than average and above average readers.

A factor that has long been recognized as influential in the learning process is perceptual sense. However, most of the effort in this domaine has concentrated on the

distinction between auditory and visual learners. Recent studies by Carbo (1980), Urshbat (1977) and Wheeler (1983) show that poor readers are often characterized by tactile and kinesthetic preferences, i.e., they learn best through experiences that involve touching and body movement. The researchers argue that such students cannot develop adequate reading skills when the material is presented primarily through auditory and visual channels. Hence, methods commonly used to teach reading such as phonics and word recognition are ineffective here.

Other researchers have examined the effect of learning style in the emotional and sociological domains. Murray (1980) looked at learning style differences in motivation, responsibility, social setting and the need for structure among students in grades 7 and 8. His results show that underachievers tend to be less self-motivated than high performance readers. Moreover, poor readers demonstrate little on-task perseverance and appear to prefer working in peer groups or with an adult rather than independently. In a summary report, Dunn (1984) relates these aspects of an individual's learning style to preferences pertaining to food intake, mobility and perceptual preferences and concludes that the learning style pattern of underachievers differs in a very consistent way from the one that characterizes high achievers.

An interrelated factor seems to be cerebral dominance. Dunn, Cavanaugh, Eberle and Zenhausen (1982) found that the learning styles of students with a left brain dominance differ significantly from those with a right brain dominance. They note that the latter prefer dim illumination, an informal seating arrangement and tactile input. They are also less bothered by sound than students with a left brain preference. Moreover, they are less self-motivated than the latter and prefer to work with friends rather than on their own. These findings suggest that there is a correlation between brain dominance and the learning style profile of different types of learners. On the other hand, Restak (1979) and Thies (1979) claim that only environmental and perceptually based preferences can be closely associated with brain dominance since they appear to be biologically determined, whereas, sociological and emotional preferences seem to be linked to the effect of interactions between people.

The findings of the above research have not gone by unheeded. More and more schools are implementing a learning style approach with academically weak students and positive results are reported by many principals across the United States (Carbo, 1984). Aside from improved reading skills, the reports also state a decrease in discipline problems, a more positive attitude to reading, greater on-task persever-

ance and a less stressful atmosphere in the classroom.

To summarize, findings from both research and classroom experience strongly suggest that the provision of contexts in which students learn through their individual learning styles allows many academically weak students to function more effectively in the classroom.

The Project

The purpose of this project was to develop, implement and assess the effectiveness of a program of study designed to teach academically weak students through their individual learning styles.

The project consisted of three parts: (1) establishing a learning style profile for each of the experimental students, (2) instituting for each student educational experiences congruent with his or her learning style and (3) evaluating the treatment.

Two schools from the English sector of the Protestant School Board of Greater Montreal (P.S.B.G.M.) participated in the project. One was the school in which the new project was implemented and the other one was the school which provided the control group. In each school, fifteen

academically weak students were chosen on basis of their past history.

The Subjects

The students came from four different grade levels (grades 3 - 6). At each grade level, there was an equal number of experimental and control students (see Table 1, for the distribution of the students across the different grades).

In each group there were more boys (nine) than girls (six) and most of the subjects belonged to families with two or more children. In the experimental group, close to half of the children (seven) were the youngest in their family whereas, among the controls, only slightly over one fourth of the children (four) were in this position. Nearly 50% of the students in each group lived in single-parent households and practically all of them spoke only English at home even though several of the parents were not native English speakers.

All the students were of average intelligence but had a long record of academic underachievement. Approximately half of them (eight in the experimental group and seven in the control group) had previously attended Prep. classes at

one or several grade levels. Four of the experimental students also had private tutors both before and during the implementation period and six of the control students were receiving Free Flow support.

An exceptionally high proportion of the experimental students (87%) had transferred to their present school at a lower grade level. Over half of these students (54%) had previously attended schools where instruction is given partially through a medium other than English (parochial schools and schools with French immersion programs). Nine of the students who had switched schools had repeated a grade and had still attended Prep. classes after that.

Most of the students exhibited multiple learning weaknesses. Some of these problems had been identified at earlier stages, however, many of them were only revealed during the implementation period. Hence, although the range of learning weaknesses was the same for the two groups, a more quantitative breakdown of the major issues could only be established for the experimental group. The most frequent problems were memory retention and concentration span (53% of the students), closely followed by weaknesses in auditory processing and auditory recall (47%) and by problems in visual attention (40%). Some students lacked fine motor skills and/or visual/motor coordination (20% and

13% respectively). In addition, 20% of the students had severe emotional problems. Finally, fully one third of the children suffered from various physical ailments (both identified and unidentified ones). Although items in this category do not necessarily interfere with the learning process, they could affect a child's emotional well-being. Moreover, physical ailments tend to result in more frequent absences from school which may, in turn, slow down academic progress.

Establishing a Learning Style Profile

In order to establish the specific preferences that characterize an individual's learning style, Dunn and Dunn (1978) have developed a learning style inventory. This inventory is based on a number of key elements contained within each of the following domains: (a) environmental, (b) emotional, (c) sociological and (d) physical.

- (a) The Environmental Domain. This domain relates to sound, light, temperature and classroom design.
- (b) The Emotional Domain. This domain pertains to motivation, persistence, responsibility and structure.
- (c) The Sociological Domain. This domain refers to working with peers vs. working alone or with an adult.

- (d) The Physical Domaine. This domaine relates to the perceptual senses, food intake, time of day and mobility.

For each element, two or more situations are posited, e.g., the light factor allows for three possibilities: bright light preference, low light preference, light not a factor.

A student's preference (or absence of preference) for a specific stimuli is established by presenting that student with a number of statements which place the learner at the center of these situations. Illumination preferences, for instance, are presented through contexts such as: "When I study, I put all the lights on." Or: "I often read in dim light." The student responds with "true" or "false" to each statement. The responses are then tallied and the teacher compares the results for a given situation with the maximum score possible for that situation. The closer the student's score is to that maximum score, the greater his or her need for this type of learning context.

The inventory can be completed by the teacher or by the student. The validity of using self-report instruments has been frequently questioned. The issue is particularly relevant when young children verbalize their reactions.

Dunn (1984) argues, however, that students seem to have no difficulty to identify their own preferences on the learning style inventory as long as these preferences are sufficiently pronounced so as to be truly important to the learner. Moreover, a study by Dunn, Dunn and Price (1977) shows a strong correlation between student responses and teacher assessments of their students' preferences in the learning environment.

In the present project, two versions of the learning style inventory were used. One was a questionnaire which the students completed on their own and the other one was a form which the teacher administered to each child individually. In the latter situation, the teacher read out each statement and the student responded orally to that statement. The teacher recorded each reaction as soon as it was presented. This procedure was used in order to provide opportunities for both visual and auditory contexts for the presentation of the stimuli as well as for the recording of the response. The first questionnaire was administered by a Special Ed. teacher a month before the project was implemented. The second questionnaire was administered just prior to the implementation period by a special resource person (hereafter Mrs. T.) who worked part-time in the experimental school and who devoted all her time to this project.

The results from the two questionnaires are presented in Tables 2-5. The data reveal, first of all, that there were a number of items on which the students' responses were very consistent irrespective of the modality through which these responses were given. This was more in evidence in the environmental domaine than in the other domaines. On the other hand, there were pronounced discrepancies between oral and written answers in the emotional domaine. It is possible that the students found it more difficult to assess their preferences in this domaine because of the abstract nature of the underlying concepts. In order to reconcile contradictory statements, Mrs. T. later discussed the relevant items with each student and together they would then determine which one of the two statements was more indicative of the students' preference.

Another problem that emerges from the results is that patterns become diffuse when there are many possible choices as illustrated by the distribution of the perceptual preferences and the optimal time of day indications (see Table 5). It is possible that, here, the difference between the self-recorded responses and the elicited reactions indicates that the learner has more than one preferred option. This notion is further supported by the fact that, in these contexts, the reactions of many students seem to depend on the situation depicted in each statement. In other words,

for some activities, a student would cite the morning as his or her preferred time whereas for others, that same student would indicate the afternoon as the preferred option. It is this combination of responses which led to the positing of a combined morning/afternoon/evening category. Similarly, the option "multisensory" evolved from the students' diversified reactions with respect to perceptual preferences.

An item by item analysis shows that the majority of the students in this sample preferred to study in a quiet and warm environment. Reactions to the light conditions in the room were less clear-cut with considerably more oral than written responses indicating a preference for bright light. However, since the discrepancy is between "bright" and "not important", the difference does not really present a problem. Classroom design was the least important environmental factor for the children and a surprisingly low number of them expressed a preference for either formal or informal settings.

The reactions to the items in the emotional domaine show that most of the students preferred to be motivated by an adult and that they functioned better when the work was presented in a structured form. Interestingly, in both cases, these preferences were more pronounced when the response was elicited orally. In a similar vein, the

students were more inclined to acknowledge a lack of on-task persistence and responsibility when they were interviewed orally when they responded in writing. It is possible that students feel freer to expose such feelings in a face-to-face situation than in the more formal paper and pencil setting.

The assessment of preferences in the social domain indicates that all of the children liked to work in a variety of settings suggesting that these preferences may be task related. In other words, on some assignments they preferred to work on their own, whereas on others they preferred to work with an adult or as part of a group. However, here again, there was considerable disagreement between the written and the oral answers when it came to choices related to group work and so it difficult to know how strong these preferences really were.

The responses related to learning modalities are also very fragmented with most students indicating more than one preference. In fact, fully one third of the students gave three or more senses as their preferred learning modalities. The others indicated strong preferences for one or the other of the following combinations: visual/kinesthetic, tactile/kinesthetic or auditory/tactile. Only very few gave a single sensory channel as their preferred modality.

The results pertaining to the physical domaine show that more than half of the students felt a need for frequent food intake and mobility. On the other hand, no clear-cut pattern emerges with regard to time-of-day preferences. This came about because most of the students gave at least three choices as their preferred times. As noted earlier, it is probable that the tasks themselves provoked this diversity of choices. Alternatively, the choice of a single time could have been perceived as too restrictive.

Implementation of the New Approach

The implementation of the special learning style program was done by Mrs. T. in conjunction with the teachers of the classes which the experimental students were attending.

Mrs. T. is an experienced teacher who specializes in teaching language arts and mathematics at the elementary level. Through her keen interest in the academic and emotional development of children and her perceptiveness of student needs, she has developed her own strategies for teaching children who experience difficulties with the academic program. Her familiarity with the learning style approach stems from her discussions with Mr. E. Cukier, guidance consultant at the P.S.B.G.M. and from extensive

reading of the literature pertaining to the implementation of techniques that would address each child's particular learning style.

The project was implemented during a period of four months, from mid-January to mid-May. During this time, Mrs. T. saw each student two or three times a week for twenty five minutes.

Mrs. T. also met frequently with the classroom teachers and suggested certain in-class interventions based on the academic needs and on the learning style preferences of each student. Thus, the implementation process occurred at two levels: (1) in a one-to-one setting where each student met individually with Mrs. T. and (2) in the regular classroom setting.

Prior to the implementation of any of these interventions, Mrs. T. analyzed the students' academic record and established an individualized program for each of the fifteen students. This program specified the areas of academic weakness and the strategies and materials that were to be used to help redress the noted gaps in achievement, e.g., "X is weak in reading. Work on story events. Find X's special interests and look for books to match these interests. Use material from a lower grade level. Teach

sight words ahead of time. Use timed teaching and echo reading." Wherever possible, an effort was made to overcome the learning weaknesses that were causing some of the problems. For example, in the case of auditory comprehension, the following instructions were given: "X needs to develop listening skills. Present projects orally. Let him record and edit his own stories."

In addition, the materials and suggested activities took into account the students' learning style preferences. Spelling exercises, for instance, were to be carried out in sand if the learner's preferred sense was tactile.

In order to enable these students to function more successfully in the classroom, Mrs. T. used a variety of exercises designed to develop general learning skills such as concentration skills and the ability to follow directions. Here again, in as much as possible, the exercises were adapted to the specific learning style preferences of each student and often the materials used to develop a certain skill would vary from one child to the other.

Sometimes advisory staff outside the school was contacted for further help, e.g., a reading expert from McGill University or a guidance counselor from the P.S.B.G.M. If necessary, the students were referred to

specialists such as speech therapists and audiologists to check if their learning problem had been correctly identified. It is through the intense follow-up of each student's case history that some hitherto unidentified causes for poor academic performance were revealed. In some cases, the specialists then suggested the use of professionally designed materials. In other cases, they advised that students be referred to special learning centers.

Mrs. T. always tried to respect the students' learning style preferences as she set up new learning experiences. Some of the stimuli, such as mobility and food intake, could be easily supplied. Others, such as social grouping and kinesthetic processing experiences were difficult to accommodate within the constraints of her set-up. Much of her attention was directed to emotional factors. A key element here was the establishment of a strong rapport with each student which enabled her to implement her academic program more forcefully.

The implementation of the project at the classroom level also involved academic interventions as well as adjustments to the characteristics of each student's learning style. At the academic level, several of the techniques and materials used by Mrs. T. were followed up. A professional package for multi-sensory processing, tape

recorded lessons in social studies and the use of a word processor for writing assignments were the most noteworthy innovations.

The extent to which the teachers were able to make provisions for learning style preferences depended on several factors. First, there was the question as to whether the conventional set-up was amenable to change, e.g., in most classrooms, lights cannot be dimmed. The second issue was whether the learning style preference did not contradict the teacher's mode of functioning in the classroom. The third factor was related to the previous one and involved the teacher's belief that the change would not upset the smooth running of the rest of the class, e.g., permitting the intake of food in class.

A detailed analysis of the provisions made by the teachers to accommodate individual learning style preferences reveals that the adjustments for preferences pertaining to the environmental domaine were least difficult to implement. In many cases, particularly with reference to sound and light, the natural classroom setting (quiet and brightly lit) was congruent with the learning style of the majority of the students. The few children who had a strong preference for the alternate situation, i.e., a noisy room or dim light, were accommodated by being seated near the

door (noisy setting) or by being placed in an area where there was no direct overhead light. Students, who had given conflicting responses on the two questionnaires and for whom no clear pattern had been established, were provided with opportunities to study sometimes under one condition (e.g., bright areas of the room) and sometimes under the alternate condition (e.g., an area where the light was less bright).

Special care was taken to let students, who preferred to study in a warm place, sit near a radiator. On the other hand, it was impossible to provide a cooler than average spot for the one student who strongly indicated such a preference.

Classroom design was not problematic since most of the students had either no preference or preferred a formal setting which was the kind of design which most teachers provided anyhow. Flexibility was allowed for those students who preferred an informal setting but were studying in a classroom that had a formal lay-out.

A major effort was made by all the teachers to provide maximal support in the emotional domaine. It will be recalled that there was much conflict here between the students' oral and written responses. Subsequent discussions between Mrs. T. and the students and observations of

how the latter functioned in a learning situation led to the conclusion that most of the children needed adult support for every one of the elements in this domaine (motivation, persistence, responsibility and structure). In consequence, the teachers tried, first of all, to provide very motivating learning contexts. Most of the teachers also made sure their students kept on task once they had started an assignment. Nevertheless, there were four children for whom no satisfactory support was devised for developing greater on-task perseverance within the classroom. A number of teachers carefully supervised the students' homework in order to develop their ability to take on responsibilities. However, here again, not all the children were followed that closely and three, in particular, would have benefited from closer monitoring of their work. Interestingly, the students themselves often felt that they could shoulder this responsibility. Yet, if supervision was not provided, the assignments were not satisfactorily completed.

The last item in the emotional domaine, namely structure, was easily provided since there was, in most cases, congruence between the way the learning experiences were set up and the students' preference. Moreover, teachers who usually used a structured approach were able to accommodate, to some extent, students with a preference for unstructured learning experiences by providing occasional opportunities

for such contexts. On the other hand, the setting up of more structured learning experiences within a classroom which provided usually unstructured contexts proved to be difficult. There was, however, only one such case.

Preferences within the sociological domaine were not difficult to implement because the classroom itself presents opportunities for individual as well as group work. Nevertheless, there were three students who could not be accommodated satisfactorily because, although they had expressed a preference for group work, they did not function well within such a context. Moreover, even though the majority of the students had indicated a broad range of preferences (alone, with an adult, with one or two peers, within a group), most of them worked only in two settings: alone and with one or, at the most, two peers.

The accommodation of preferences within the physical domaine proved to be the most difficult to carry out. A major problem was the setting up of learning tasks congruent with the students perceptual preferences. Many teachers tried to make adjustments, however, since most of the readily available materials are oriented towards auditory and visual processing, the learning experiences that were provided accommodated primarily preferences in these two processing modes. It follows that students, who preferred

to function through their tactile and/or kinesthetic senses (two thirds of the students included one or the other of these modalities in their responses), were only partially accommodated. Moreover, in those instances where learners gave only tactile and/or kinesthetic preferences, there was little congruence between the student's preferred perceptual learning style and the learning experience in the classroom.

Food intake during lessons presented another type of problem. Here the issue was that several of the teachers had set up a rule whereby food was not permitted in the classroom. Thus, allowing some students to eat in class would have meant a conflict between what was permissible to these students and what was permissible to the rest of the class. Hence, half of the students who indicated a need for frequent food intake were not accommodated on this item.

The element that was most frequently left unattended was the students' preferred study time. In some cases, this was due to scheduling problems which went beyond the confines of the classroom. In others, there was not enough flexibility within the classroom itself. Moreover, students who showed only late afternoon and evening preferences could not be accommodated within the school day at all. Luckily, most students included both morning and afternoon alternatives in their responses and they were thus partially

accommodated without substantial changes in their schedules. Moreover, there were three students whose schedules were, in fact, adjusted so that the times at which they did most of their classroom work were completely congruent with their time of day preferences.

Provisions for mobility needs were fairly extensive. Out of the eight students who indicated a clear need to move around, three were permitted to do so freely and another two were given some opportunities for greater freedom of movement. Furthermore, two students for whom no clear pattern could be established were also given more flexibility on this point.

In summary, the findings pertaining to the implementation of the learning style approach reveal that, although both Mrs. T. and the classroom teachers tried to provide settings congruent with each student's particular learning style, student preferences could not always be accommodated. This is particularly true of those preferences that require the setting up of very special learning experiences as is the case when students want to learn through their tactile and kinesthetic senses. Moreover, some conditions could not be met because of external factors. The provision of dim light is a case in point. Although an effort was made to allow students to study in areas which were

considered less brightly lit than others, these light conditions were, in most cases, not really dim.

Evaluation

Two types of evaluation were carried out in order to assess whether the techniques that were being used with the fifteen experimental students had a positive effect on the students' performance in the classroom. The first was a formal evaluation and the second was an informal one.

The Formal Evaluation

The formal evaluation consisted of a detailed assessment of the students' English and mathematics skills. The tests used for this purpose were the Canadian Tests of Basic Skills (CTBS, Multilevel Edition, metric version). The test battery consisted of three English language tests (vocabulary, reading and language) and three mathematics tests (concepts, problem solving and computation). The language test was further subdivided into spelling, capitalization, punctuation and usage. The format of all these tests was a multiple-choice one.

Four different test levels were used in accordance with the four grade levels covered by the project. Each student

was given the battery of tests that corresponded to the grade level at which he or she was studying.

The students were tested twice, once prior to the implementation of the project (pre-test) and once at the end of the implementation period (post-test). A different form of the test was used at each of the two periods (Form 5 was used for the pre-test and Form 6 for the post-test). In the experimental school, the pre-and post-tests were administered by the same persons. In the control school, the tests were administered by a different person at each time. None of these people were the students' classroom teachers. They were, however, people with whom the students were familiar.

For the statistical treatment of the data, the raw scores obtained on the tests were transformed into grade equivalents and into percentile ranks. These scores were then submitted to a two-way analysis of variance. The independent variables were group (experimental vs. control) and testing time (pre vs. post). Separate analyses were carried out for each test.

The Informal Evaluation

The informal evaluation was carried out only in the experimental school and was based on the classroom teachers'

assessment of the students' progress. Its purpose was to see whether a noticeable change had occurred in the way the children functioned in class. Three areas of student performance were examined: (a) academic work, (b) behavior in the classroom and (c) emotional development.

(a) Academic Work

Academic work was assessed in three subject areas: reading, other language arts and mathematics. In order to provide teachers with an opportunity to note any other changes in the academic field, a category entitled "other" was included.

(b) Behavior

This item related to four aspects of student behavior in the classroom: discipline, attention span, relation with peers and relation with the teacher.

(c) Emotional Development

Two aspects of emotional development were looked at: attitude to study and on-task perseverance. Moreover, here again, the category "other" was included to give teachers the opportunity to add further observations.

The teachers were asked to record their answers on a form which was especially developed for this evaluation. The forms were distributed at the end of the implementation period and a separate form was to be completed for each student. In addition, the researcher met with the teachers in order to discuss how they felt about this new teaching approach.

Results

The Formal Evaluation

The results from the formal evaluation are summarized in Tables 6-8. Table 6 shows the mean percentile ranks of each group on the pre-tests and on the post-tests. Tables 7 and 8 give the mean grade equivalent scores obtained at each grade level.

The outcome of the statistical analysis reveals a main effect for time on two of the tests: vocabulary and usage. Moreover, there is a significant interaction between time and group on both of these tests as well as on the spelling test. Closer examination of the data shows that, on all three tests, the performance of the experimental group improved markedly over time whereas that of the control group showed either little change or a noticeable decrease

in achievement (spelling).

A visual comparison of the percentile scores on the other tests indicates that, even when the difference between the groups was statistically not significant, the scores of the experimental group increased numerically more than those of the control group. The only test where this pattern did not apply was the reading test. Here, the scores of the experimental group remained steady between the two testing periods whereas those of the control group increased to some extent.

An inspection of the experimental students' individual reading scores reveals that only six of these students demonstrated markedly higher achievement in reading on the post-test by comparison to the pre-test. Further analysis of the data shows that when learning style preferences are taken into account, the experimental students whose scores did not improve over time were studying more frequently under conditions that were not congruent with their learning style than students whose scores showed improvement. This was most evident in the physical domain. Six out of nine students were either not accommodated or accommodated only partially for perceptual stimuli, time-of-day preferences and mobility. Four of them were also not accommodated for food intake.

In terms of grade level attainment, the results show that, at the time of the post-test, the grade 3 students in the experimental group were performing at or above grade level on all the tests except capitalization. In contrast, the grade 3 controls were performing below grade level on all the tests except reading and problem solving. In grade 4, the experimental students were performing at or above grade level on the vocabulary test and on the mathematics computation test. On all the other tests, their achievement was below grade level. The grade 4 students in the control group performed almost at grade level on the vocabulary test and below grade level on all the other tests. The grade 5 students were the weakest ones and both groups achieved consistently below grade level here. Moreover, on two tests (capitalization and usage), the gap between student performance and the expected grade level was over .20 months. The grade 6 students in both groups also performed below grade level on all the tests. However, here the difference between the experimental students' achievement and the norm for that level did not exceed 20 months on any test.

In interpreting these findings, it should be borne in mind that there was considerable variability in the individual scores within a given grade. Thus, some students performed at a considerably lower level than the averages shown here whereas others, though few in number, reached

noticeably higher levels of achievement. Moreover, a student's performance was rarely uniform across all the tests. It is, however, the overall trends which are of interest here since the evaluation pertains to the assessment of a program rather than to individual attainment.

Aside from academic achievement, the formal evaluation also provided an opportunity to assess the students' ability to complete a task within a given amount of time. Here, the data shows that, on the pre-test, only seven experimentals and six controls completed all the test items. On the post-test, all but one of the experimental students finished the tests whereas only 10 controls (67%) filled in all the answers. Thus, there were noticeably more experimental than control students who improved their performance on this measure.

The Informal Evaluation

The first thing to note about the informal evaluation is that the teachers did not always relate to all the items on the forms that were distributed. Often they referred only to those items which they felt were the ones that needed working on. At other times, they indicated that the forms were not appropriate to capture a particular student's problem and they, therefore, concentrated on a description

of the problem rather than on the change that had or had not occurred in the student's performance and behavior. It follows that not all of the students are represented in the data provided for each item. On the other hand, several teachers added items such as classroom participation and homework which were not on the original form. These items were also included in the analysis (see Table 9).

When the teachers' responses for each item were organized according to clearly defined ratings of achievement, three major categories emerged namely "poor", "improved" and "good". Students whose performance (or behavior) was rated as "very good" or "excellent" were included in the category "good" in order to avoid further fragmentation of the data. In a similar vein, ratings of "fair" were included in the category "poor".

The results of the informal evaluation show that, prior to the implementation of the project, the performance (or behavior) of the majority of those students for whom such data was available was considered "poor." However, by the end of the implementation period, a major shift had occurred from "poor" to "improved." In the area of academic work, 63% of the students (7 out of 11) showed improvement in reading, 42% improved in other language arts and 46% showed progress in mathematics. Nevertheless, only one student

improved his performance sufficiently so as to be considered "good" in academic work and even here the rating applied only to one item, namely "other language arts." On the other hand, a positive change was also noted for four students in the areas of classroom participation and homework.

Much progress was noted on three items in the behavioral domaine. Discipline and relations with peers improved in all cases where a problem had been noted prior to the implementation period (three students in each case). Moreover, attention span improved with nine out of the ten students (90%) for whom this item was a source of trouble. Interestingly, the relationship between teacher and student was the only item which was never rated as poor. There were, however, two instances where this relationship was reported to have been only "fair" during the initial period. In one of these cases, the rating improved considerably over time, whereas in the other it remained steady. Finally, in the emotional domaine, two out of three students showed a more positive attitude to study by the end of the implementation period and four out of seven students (57%) demonstrated greater on-task perseverance.

Often, the teachers also wrote comments to explain why they thought their students had or had not improved in their

academic performance or in their behavioral and emotional development. Most of them attributed the change they noted to the one-to-one interactions with Mrs. T. All of them seemed to feel that, in most cases, emotional problems were the underlying cause of poor academic achievement and that the contact with Mrs. T. had enabled the students to open up and express their problems to her. This, in turn, was thought to have led to a change in the students' attitude to study and to an improvement in their ability to concentrate in class. The development of greater self confidence was another item that was felt to have a positive influence on the way a student functioned in the classroom. On the other hand, improvement in the emotional domaine was not always accompanied by better academic achievement. In two cases, teachers noted that students were putting more effort into their work and were staying on task for longer periods, yet their academic work remained poor. It should be noted here that some teachers measured progress more in terms of the extent to which their students could function at the expected grade level than in terms of improvements in performance. Hence, there may have been some slight improvements here which were not recorded.

The teachers' stress on performance at the appropriate grade level emerged even more forcefully during the meeting the teachers had with the researcher. Most of the teachers

felt that they did not have the means to provide the kind of special programs these students required. Several of them also indicated that they had to cope with many different problems in the classroom and, therefore, they did not have enough time to give these students more individual attention. They were all very appreciative of the work Mrs. T. had done and they felt that such one-to-one sessions should be increased. Interestingly, the teachers did not seem to be really familiar with learning style theory and its implications for the classroom set-up. Most of them indicated that the accommodations they had made for these students were done either as a result of Mrs. T.'s recommendations or on basis of their own teaching experience.

Summary and Discussion

The findings of the evaluation of this project can be summarized as follows:

- (1) On the pre-test, there was no significant difference between the experimental group and the control group on any of the tests.
- (2) On the post-test, the experimental group scored significantly higher than the control group on three tests: vocabulary, spelling and language usage.

- (3) Between the pre-test and the post-test, the scores of the experimental group increased numerically on all the tests except the reading test.
- (4) There was greater improvement in the ability to keep on task among the experimental students than among the controls.
- (5) According to the teacher assessments, more than half of the very weak students improved their scholastic achievement and practically all of those who had behavioral and emotional problems showed some improvement in these areas.
- (6) At the end of the implementation period, the grade 3 experimental students performed at or above grade level on practically all the tests. The other experimental students and all the controls performed below grade level on most of the tests.

The major outcome of this project is that there are indications that the performance of the experimental students has improved not only in terms of academic achievement but also in terms of behavioral and emotional characteristics such as on-task perseverance. In accepting these findings, it must, however, be borne in mind that the

results pertain to group trends and that they do not apply equally to all students.

The finding that the improvement in academic achievement was only significant on some of the tests could, of course, be due to the fact that the implementation period was relatively short. On the other hand, it is interesting that progress was most pronounced in areas of the language arts program which deal with clearly definable elements of language development. Moreover, two of these areas (spelling and vocabulary) figured prominently on some of the individualized programs which Mrs. T. had developed for the students. Thus, the findings suggest that the sessions with Mrs. T. may have had more impact on academic achievement than the accommodations that were made in the classroom.

The results of the formal evaluation also indicate that most of the students were still performing below grade level at the end of the implementation period. It can be argued that the findings are not really surprising since one would not expect students who are academically so weak to be able to bridge the gap between their previous attainment and the standard norm in so short a time. Interestingly, underachievement was much less pronounced in grade 3 than in the other grades. Moreover, even when performance was considerably below the expected norm at that grade level on the

pre-test, as in the case of punctuation and usage, the students were able to narrow the gap much more successfully than students in other grades. It is possible that individual differences play a salient role here since the number of students at each grade level was very small. On the other hand, it is plausible that academic deficits are more difficult to overcome in the higher grades because of the cumulative effect of persistent underachievement. It should be noted that the findings of the formal evaluation correlate with the assessments made by the teachers, namely that the improvement noted in scholastic achievement was insufficient to raise the level of performance of these students to the extent that they would be able to follow the regular program. The only result that contradicts to some extent, the assessments made by the teachers is the one pertaining to reading achievement. Here, the scores of the experimental students did not improve over time on the formal evaluation, whereas the teachers reported some progress in reading for more than half of the students. It is possible that the teachers were reacting to the students' overall ability to read material which they encountered in the classroom and that such reading experiences differ from the reading tasks that were provided by the test. On the other hand, the findings also suggest that the lack of progress in reading may be related to an insufficient accommodation of learning style preferences, particularly in the physical domain.

In summary, two factors have been cited here as possible causes for the limited improvement in student performance. The first is the duration of the implementation period and the second is the scope of the arrangements made to provide the students with conditions congruent to their learning style. A related issue is whether the teachers were sufficiently involved in the project. Their own reactions strongly suggest that they were implementing isolated aspects of the learning style approach without being fully aware of the overall dimensions of this undertaking. Moreover, the teachers may not have been convinced of the usefulness of such strategies since they attributed most of the progress their students had made in the academic field as well as in the behavioral and emotional domains to the interactions between Mrs. T. and the students.

These arguments lead to the conclusion that, if the project is continued next year, it would be advisable to implement it over the entire ten-month period. Furthermore, it may be beneficial to invite the teachers to a special workshop which would focus on the rationale of the learning style approach and on guidelines for its implementation in the regular classroom. Follow-up meetings should take place during the year so as to provide the teachers with an opportunity to discuss any problems that may arise during the implementation period. An evaluation of this phase of the project would then supply the necessary feed-back on the efficacy of these measures.

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Table 1

Number of Participating Students
at each grade level

	Experimental	Control
Grade 3	2	2
Grade 4	5	5
Grade 5	5	5
Grade 6	3	3

Table 2

Student Preferences in the Environmental Domains

	Self recorded		Teacher recorded	
	#	% ^a	#	%
Sound				
Quiet	11	73	9	60
Noisy	1	7	3	20
Not Important	3	20	3	20
Light				
Bright	5	33	10	67
Low	2	13	1	7
Not Important	8	53	4	27
Temperature				
Warm	11	73	11	73
Cool	2	13	1	7
Not Important	2	13	3	20
Design				
Formal	1	7	2	13
Informal	4	27	1	7
Not Important	10	67	12	80

^a Percentages have been rounded off, hence they do not always add up to 100.

Table 3

Student Preferences in the Emotional Domain

	Self recorded		Teacher recorded	
	#	%	#	%
Motivation				
Self motivated	1	7	0	-
Adult motivated	1	7	9	60
Teacher motivated	0	-	0	-
Self & other motivated	12	80	6	40
Not motivated	1	7	0	-
Persistence				
Persistent	12	80	0	-
Not Persistent	2	13	13	87
Not definable	1	7	2	13
Responsibility ^a				
Responsible	11	79	0	-
Not very responsible	2	14	8	57
Not definable	1	7	6	43
Structure ^b				
Needs structure	3	23	12	92
Needs little structure	3	23	2	8
Not Important	7	54	0	-

^a One student did not respond to this item.

^b Two students did not respond to this item.

Table 4

Student Preferences in the Sociological Domains

	Self recorded		Teacher recorded	
	#	%	#	%
Work & Study Preferences				
Alone	0	-	9	60
With a peer	0	-	0	-
With an adult	0	-	0	-
With several peers	0	-	0	-
Alone & a peer	3	20	0	-
A combination	12	80	6	40

Table 5

Student Preferences in the Physical Domains

	Self recorded		Teacher recorded	
	#	%	#	%
Perceptual Preferences				
Auditory	0	-	1	7
Visual	1	7	0	-
Tactile	1	7	3	20
Kinesthetic	1	7	0	-
Auditory/tactile	1	7	2	13
Visual/kinesthetic	4	27	1	7
Tactile/kinesthetic	1	7	3	20
Multisensory	6	40	5	33
Nutritional Intake				
Requires intake	7	47	10	67
Does not require int.	5	33	2	13
Not important	3	20	3	20
Functioning Time				
Early morning	1	7	0	-
Late morning	2	13	0	-
Early and late morning	2	13	0	-
Afternoon	1	7	5	33
Evening	1	7	0	-
Afternoon & evening	1	7	0	-
Morning & afternoon	6	40	8	53
Not important	1	7	2	13
Mobility needs				
Needs mobility	8	53	9	60
Does not need mobility	3	20	1	7
Not important	4	27	5	33

Table 6

Summary of Results for the Entire Sample^a

	Exp'tal		Control		F ratios		
	Pre	Post	Pre	Post	Pre/Post	Group	Interaction
Vocabulary	30	55	39	41	12.13**	0.08	8.52**
Reading	30	30	29	37	0.86	0.11	1.19
Spelling	23	38	36	30	1.05	0.60	4.86*
Capitalization	18	27	22	23	1.12	0.00	0.93
Punctuation	27	37	29	38	3.71	0.40	0.00
Usage	17	37	31	29	5.52*	0.23	7.80**
Math concepts	26	37	31	35	1.77	0.03	0.50
Problem solving	24	37	35	35	2.50	0.39	2.72
Computation	29	40	36	39	2.01	0.12	0.66

* $p < .05$ ** $p < .01$ ^a Scores shown are percentile scores.

Table 7
Summary of Grade Equivalent Scores
EXPERIMENTAL GROUP

	Grade 3		Grade 4		Grade 5		Grade 6	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Vocabulary	35	41	34	48	48	55	55	51
Reading	36	38	41	33	40	47	60	60
Spelling	38	45	33	44	38	41	37	51
Capitalization	28	34	26	36	43	34	48	60
Punctuation	23	38	33	43	48	44	59	51
Usage	27	38	29	43	37	37	43	58
Math concepts	35	40	36	44	44	43	54	63
Problem solving	37	43	37	44	38	42	51	49
Computation	39	46	38	51	49	45	56	60

Table 8

Summary of Grade Equivalent Scores

CONTROL GROUP

	Grade 3		Grade 4		Grade 5		Grade 6	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Vocabulary	27	21	47	47	48	51	36	54
Reading	27	38	40	42	44	43	45	53
Spelling	21	29	39	34	50	43	47	47
Capitalization	29	29	31	35	31	31	54	52
Punctuation	19	32	45	44	32	38	51	58
Usage	20	23	41	43	38	34	56	38
Math concepts	24	28	41	45	46	42	49	57
Problem solving	32	38	42	38	43	43	57	58
Computation	33	34	42	43	47	45	61	58

Table 9

Teacher Assessment of Student Progress over Time^a

	Before		After		
	Poor	Good	Poor	Improved	Good
Academic Work					
Reading	11	2	4	7	2
Other language arts	12	1	7	4	2
Mathematics	11	1	6	5	1
Classroom particip.	4	1	0	4	1
Homework	5	2	1	4	2
Behavior					
Discipline	3	7	0	3	7
Attention span	10	4	1	9	4
Relation with peers	3	6	0	1	8
Relation with teacher	2 ^b	4	1 ^b	0	5
Emotional character					
Attitude to study	3	3	1	2	3
Perseverance	7	3	3	4	3

^a Figures represent number of observations recorded for each item. Not all students were assessed on every item.

^b Relationship was actually listed as "fair."



